Laboratoire d'Informatique Fondamentale et Appliquée de Tours
EA 6300 – ERL CNRS 7002

Laboratory of Fundamental and Applied Computer Science of Tours

LIFAT / PolytechTours – 64 av. Jean Portalis – 37200 Tours - FRANCE
Phone : (+33) 2 47 36 14 42 / **Email :** lifat@univ-tours.fr / **Web :** lifat.univ-tours.fr

Tours/Blois - Loire valley - France

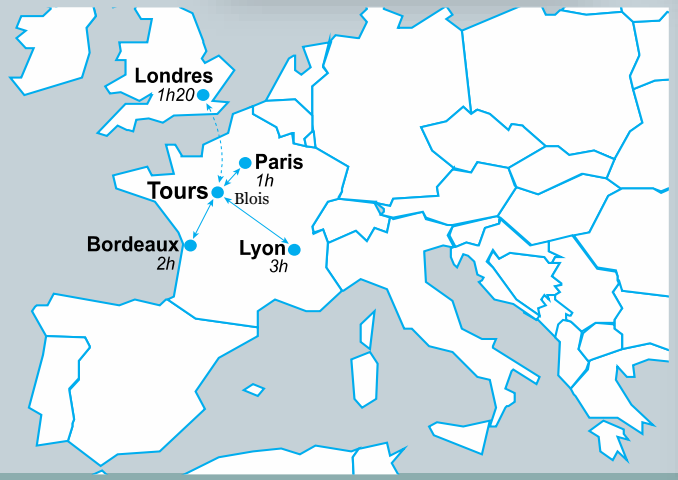
City of Tours

- **130,000 citizens (≈ 300,000 in the urban area)**
- **30 TGV directs/day to/from Paris (1h)**
- 300 km of bike lanes
- 1,200 public bikes
- A 360 km public transport network

The Loire Valley & Blois

The heart of the Loire Valley: an exiting region to discover

- Les chateaux de la Loire
- Les vignobles de la Touraine



Associated with Engineering schools

POLYTECH GROUP / NETWORK

- Group of **14 graduate school of engineering**
- More than **13 %** of engineer degree in France
- 14,000 engineering students
- 3000 graduates every year
- 125 research labs
- 1,200 Ph.D. students

INSA GROUP / NETWORK

- Group of **6 graduate school of engineering**
- Around **10 %** of engineer degree in France
- 12,400 engineering students
- 1100 graduates every year
- 53 research labs
- 1,200 Ph.D. students

UNIVERSITY OF TOURS

- **27 000** students
- Pluridisciplinary university
- **More than 1500** faculty members
- 73 Research labs

LIFAT
EA
63
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Organization LIFAT (EA 6300 – ERL 7002)

49 enseignants-chercheurs
31 doctorants - 11 Postdocs
3,2 IATOS

Directeur du Laboratoire : Jean-Yves Ramel

Dir. adjoint : Arnaud Giacometti

Conseil de Laboratoire
2 représentants par equipe + représentants BIATS et doctorants

Correspondant international (labri): Mathieu Delalandre

Equipes internes

BDTLN
Resp : Beatrice Markhoff

RFAI
Resp : Nicolas Ragot

ROOT (OC)
Resp : Vincent T'Kindt

ERL CNRS 7002

Service administratif
Responsable
Christelle Grange

Secrétariat :
Christelle Grange
Annie Simon

Services partagés avec PolytechTours

Antenne financière
*Resp. :*Stéphanie Goubin

Christèle Popelin

Service technique informatique
Commun avec PolytechTours
M. Rousseau, Y. Gorends

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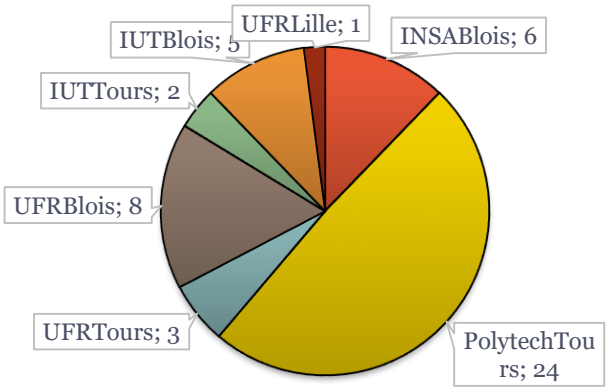
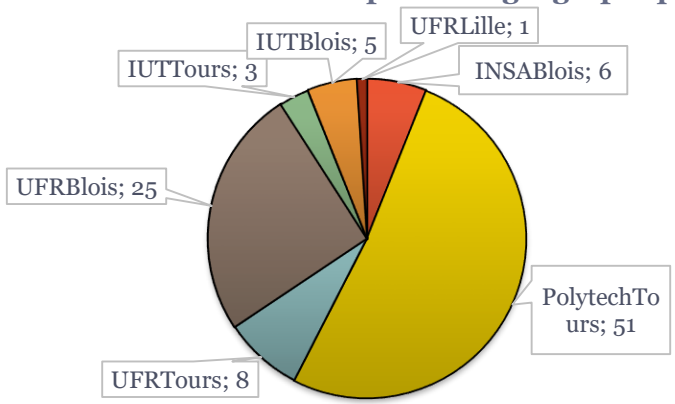
Répartition géographique (MCF+PR)



Répartition géographique (All)



	Poste R Boné									
Site	LIFAT	PR	MCF	Doctorants	Posrdoc	IATOS	BDTLN	RFAI	OC	MCF+PR
INSABlois	6	1	5	0	0	0	0	5	1	6
PolytechTours	51	9	15	16	4	5	1	20	22	24
UFRTours	8	0	3	4	1	0	7	1	0	3
UFRBlois	25	3	5	10	5	2	23	0	0	8
IUTTours	3	1	1	0	1	0	2	1	0	2
IUTBlois	5	0	5	0	0	0	4	0	1	5
UFRLille	1	1	0	0	0	0	0	1	0	1
Total	99	15	34	30	11	7	37	28	24	49
					%devenus 1 !					

Scientific skills according to publications

Word cloud from keywords of publications in journals since 2016

Organization

LIFAT EA 6300

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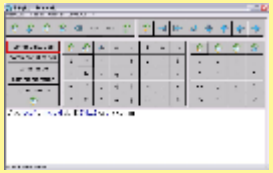
Organization

Scientific Skills

BDTLN team



- Natural Language Processing and interaction
- Data mining and data warehouse
- Web data and services
- Spatial & spatiotemporal data processing

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Scientific Skills

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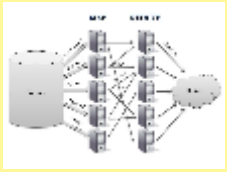
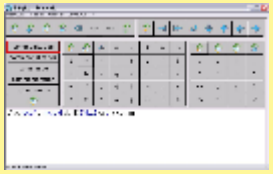

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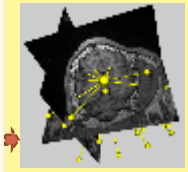
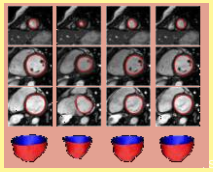
RFAI team

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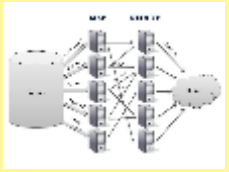
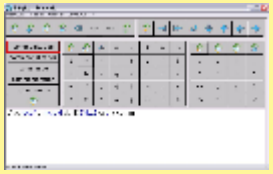

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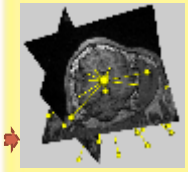
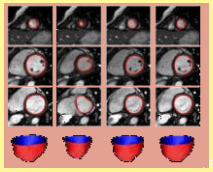

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CNRS

ROOT team

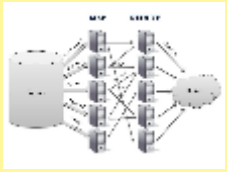
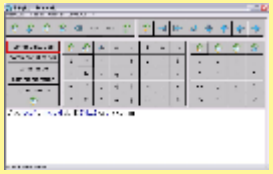
ERL
CNRS 7002

- Operational research and combinatorial problem solving
- Scheduling models for Transportation and Big Data systems
- Multi-criteria optimization: path search, resource planning, ……

Organization

Scientific Skills

BDTLN team

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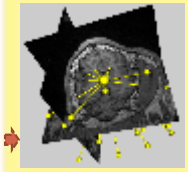
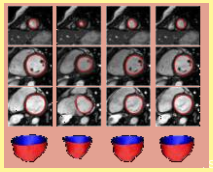

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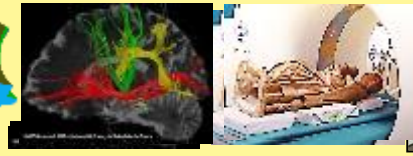
ILIAD3 center

- ILIAD3 is a center for technology transfer associated to the LIFAT.
- Development and industrial transfers of prototypes produced by researchers
- Digitization and processing of 3D data
- Consultancy and training



Main Application Domains

Application domains

Digital Humanities

Transcription tools for historical books, data warehouse and web services for cultural heritage, optimization of touristic paths, virtual visits, etc.

Health and Disability

Medical image analysis, visualization and mining of medical data, optimization of patient pathways, interactive devices for disability, etc.

Partners & Projects

H2020 COST PARSEME
H2020 ARIAD-NE+
ANR SESAMES (LAT)
APR SmartLoire (CESR)

CEFIPRA (ISI-Inde)
ANR Fibratlas (INSERM)
APR NeuroGeo (INRA)
CIFRE Imascap

ANR BNBF EVAC
ANR MECANO
APR TRADE / Big Trend
CIFRE Cyres, Geovelo

Sculpture 3D exposition
ANR Fibratalas2
APR Visit
SILA 3D prototype

Inserm U930 Institut national de la santé et de la recherche médicale
INRA 70 ans SCIENCE & IMPACT
CIRE
citeres UMR 7324
TALM esba École supérieure des beaux-arts Tours Angers Le Mans - Site de Tours
CESR
recherche Intelligence des Patrimoines innovation
Tours Poitiers Neuroimagerie Fonctionnelle SFR FED4226 Structure Fédérative de Recherche
CaSciModOT
CYRÈS Groupe
vinopôle Centre Val de Loire

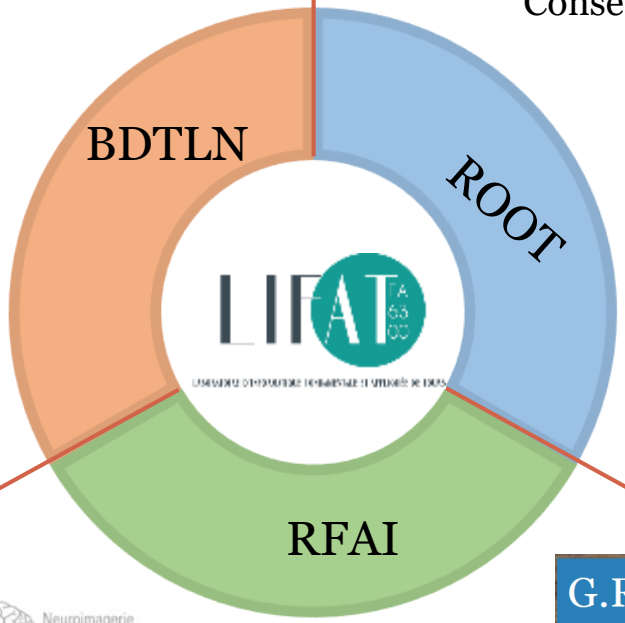
fédération ICVL
Informatique Centre Val de Loire

ICVL Federation

The federation aims to:

- enhance and improve the visibility of IT research activities in the Center-Val de Loire Region
  - generate and promote research projects at the regional, national and international levels
  - boost the research activity in both units and encourage their collaborations
- build a pole of excellence in the efficient, reliable and secure acquisition and processing of digital information
- The ICVL is structured in 3 main research areas:
  - Massive, complex or heterogeneous data
  - Algorithms and optimization
  - Security, reliability and performance

National & international involvements



Réseau Banque Mondiale
CEA-MITIC

Chair of the management committee

Conseil scientifique

CENTRE D'EXCELLENCE AFRICAIN EN MATHEMATIQUES, INFORMATIQUE & TIC (CEA-MITIC)

Conseil scientifique

GT GDR CNRS MI

GT GDR CNRS RO

Management Committee

Secrétariat
CA

Projet international

Secrétariat, CA

Présidence

Présidence
Vice-Présidence

Présidence

Présidence

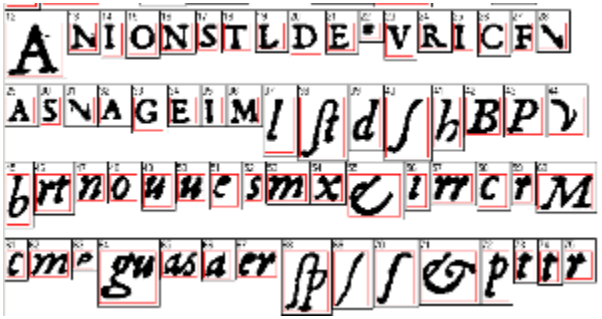
Bourse JSPS

Some examples of research projects

- Interactive transcription for Digital Humanities
- Medical Image Analysis
- Emotions Analysis
- Surgical operations with Augmented Reality
- Help for communication with NLP
- Optimisation of city evacuation
- Production and Planning of Chemotherapies
- Etc…

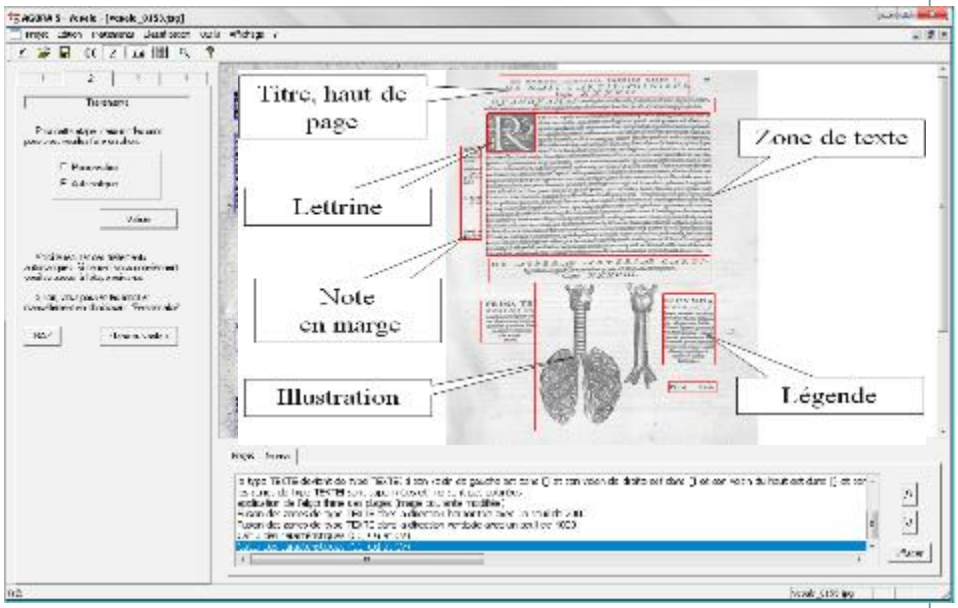
Interactive transcription for Digital Humanities

- **Paradiit**: Google Award in DH
- Agora software ➔ Interactive extractions of Regions of Interest (EoC)
  - Generation of XML files describing the structure of images
  - First version in 2011 (CESR)



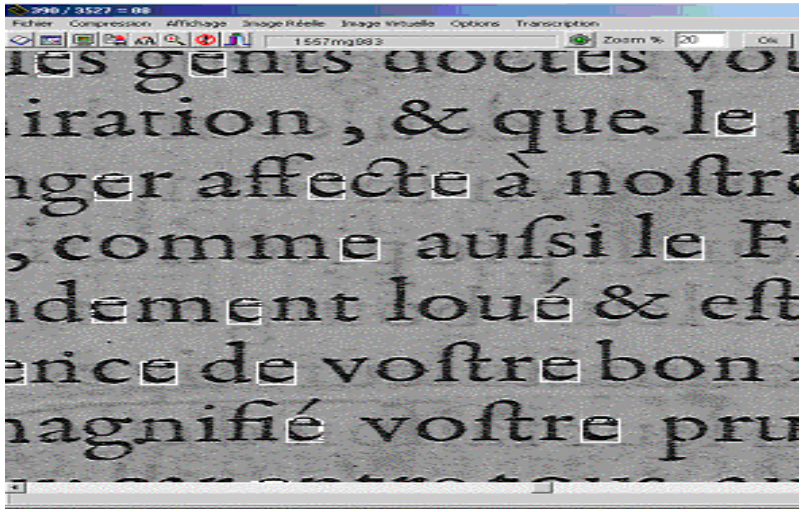
- Batyr dataset
- **Bases of dropcaps (+ de 24000)**

- **Bases of portraits (+ de 1500)**



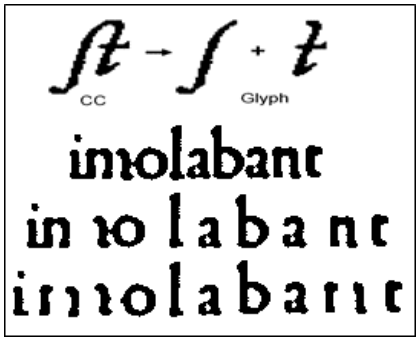
Intreactive transcription for Digital Humanities

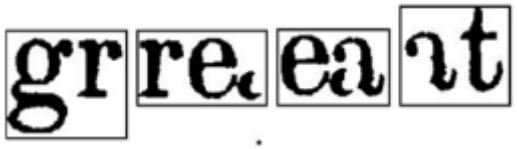
- Redundancy analysis of EoC (shapes)
  - Extraction and Clustering of Similar shapes
  - Without a priori or knowledge about the semantics of these shapes



- The constraints to be respected are:
  - Produce very homogeneous clusters ➔ Prohibit confusion and bad classifications
  - Produce a minimal number of clusters

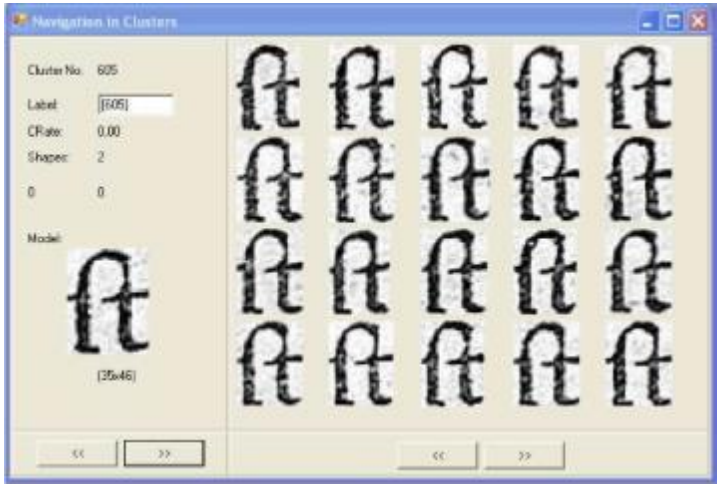
- Which shapes?
  - Connected Components [Lebourgeois95]
  - Words [Kluzner & Al2009]
  - Other (glyphs) [Roy & Al2011]
- Redundancy rate> 80%

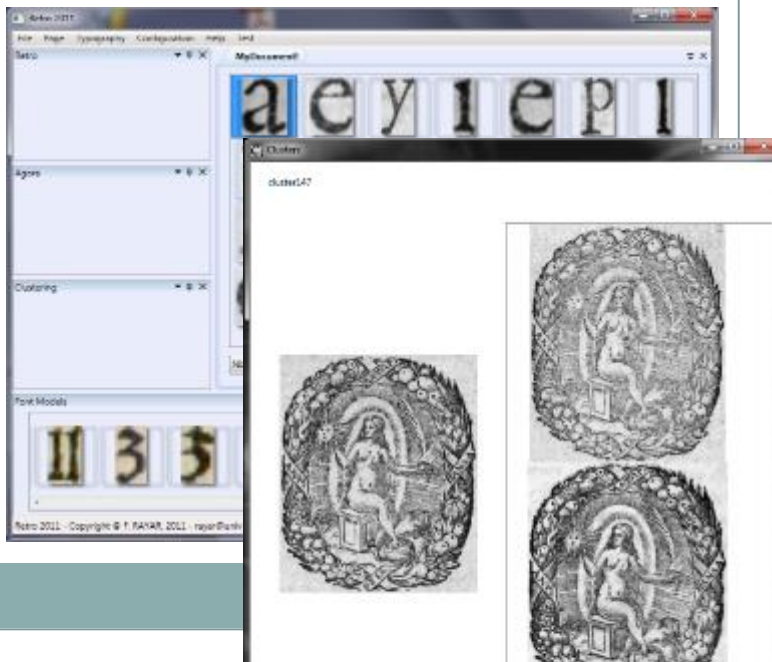




Interactive transcription for Digital Humanities

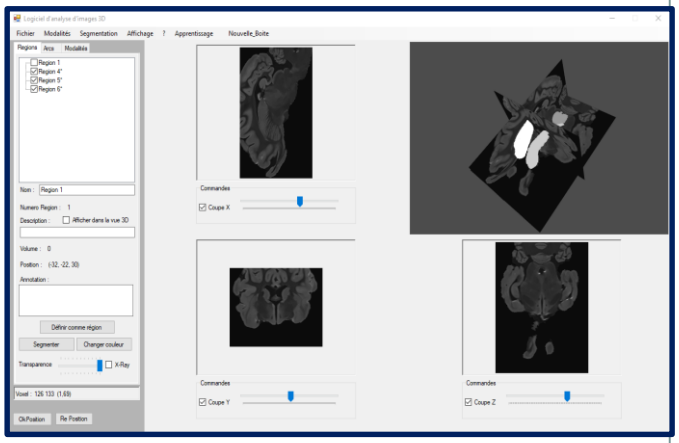
- Cluster Analysis Interface (Retro) ➔
- EoC characterization
  - Pixels (NdG? B & W?)
  - Geometric moments (Zernike)
- Comparison method
  - Can not compare all shapes together
  - Choice of method / distance (BIRCH)
- Cluster representatives
  - Computation time and complexity
  - 1 book = several days ➔ Parallelism
  - M. of files ➔ Big data

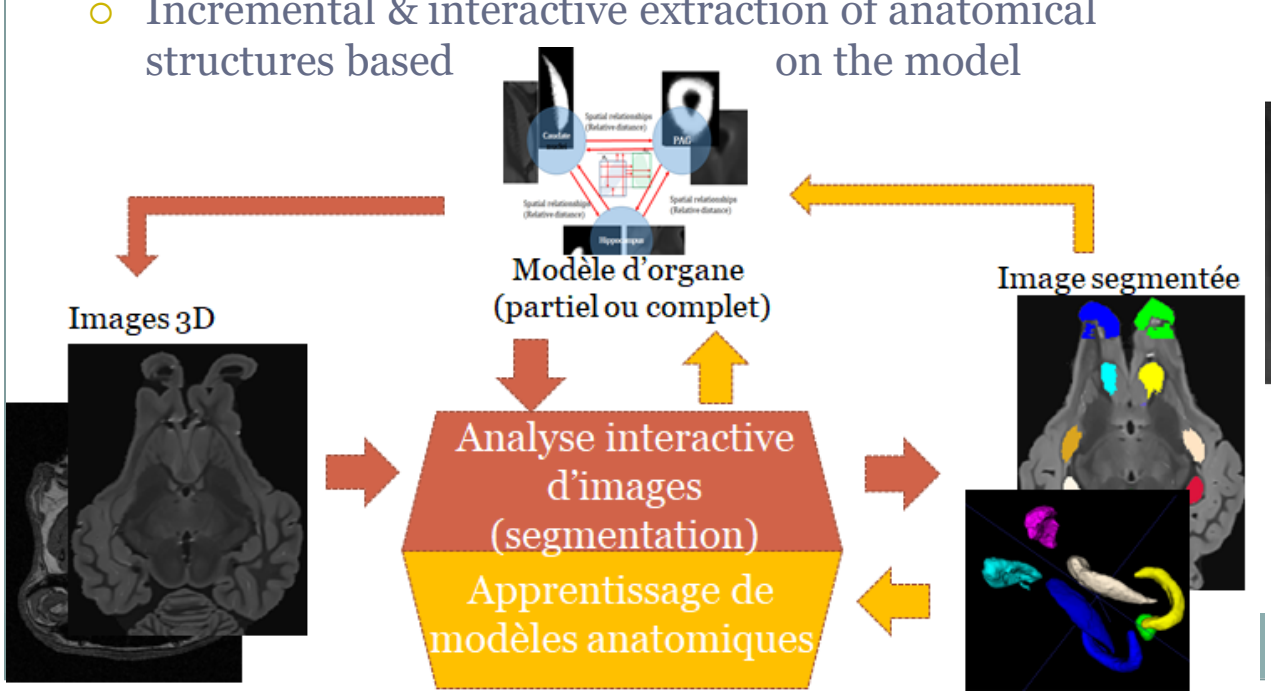


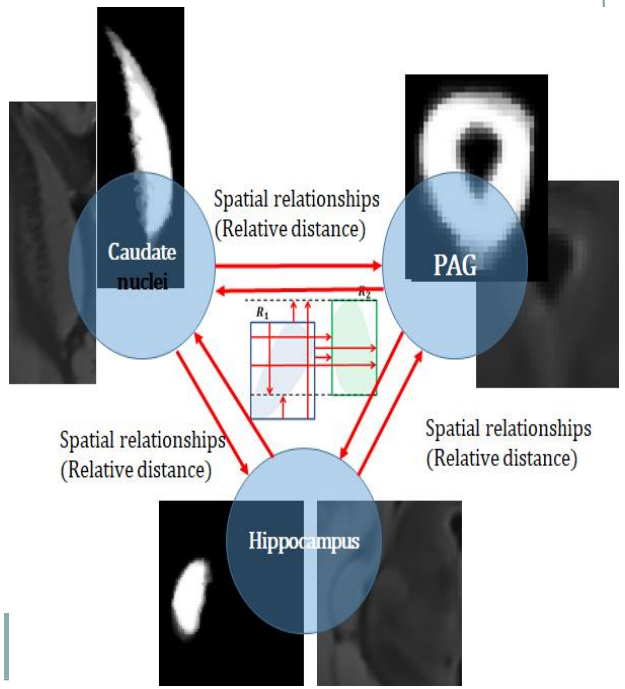


Medical images analysis

- Proposition of **SILA 3D** framework
  - Segmentation of 3D MRI or scanner images
  - Genericity: Brain, heart, …
- Based on a combination between local atlases and a topological graph (the model)
  - Automatic learning of the model of the organ
  - Incremental & interactive extraction of anatomical structures based on the model

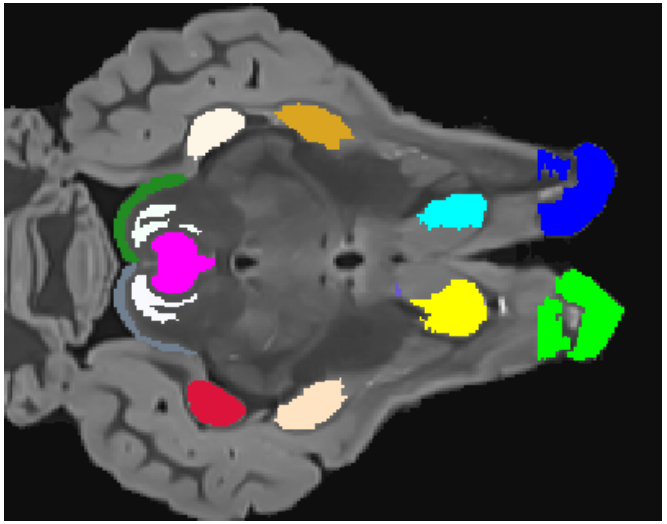
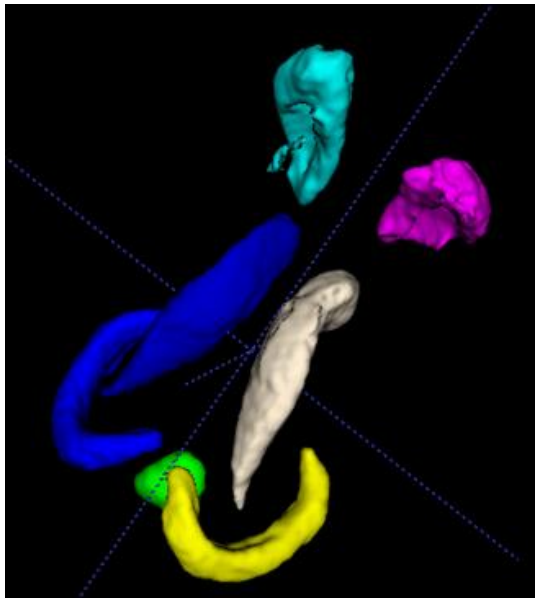
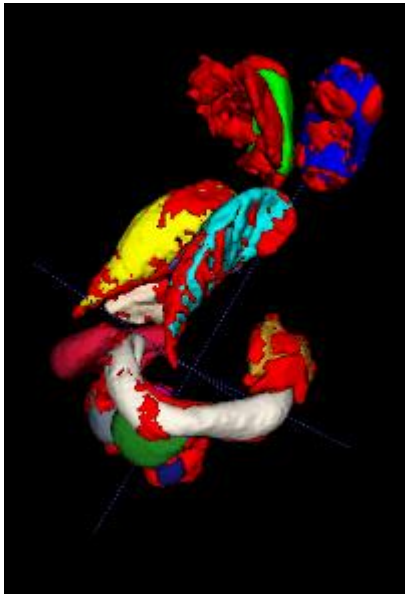
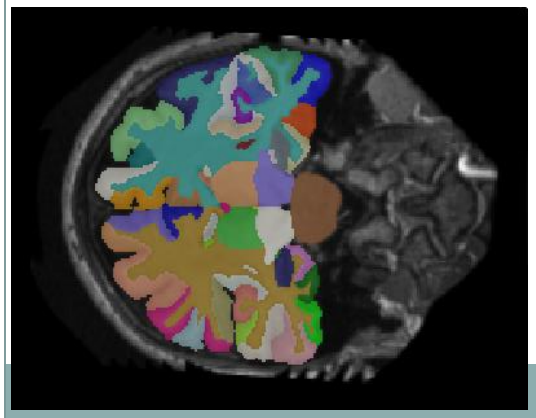
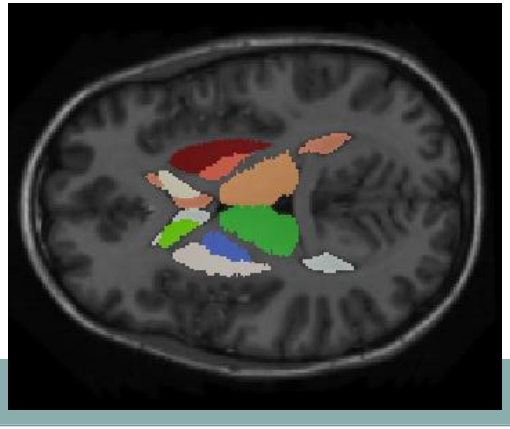
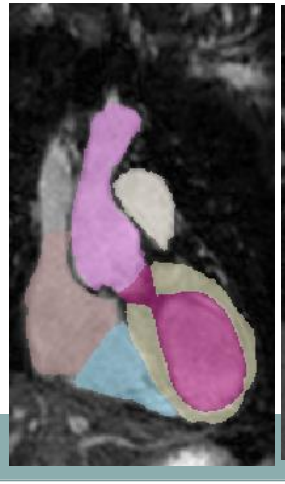
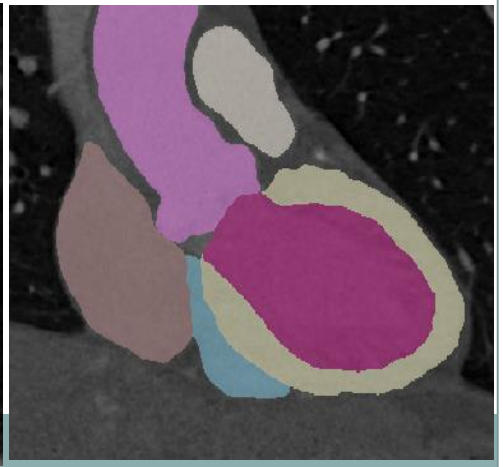






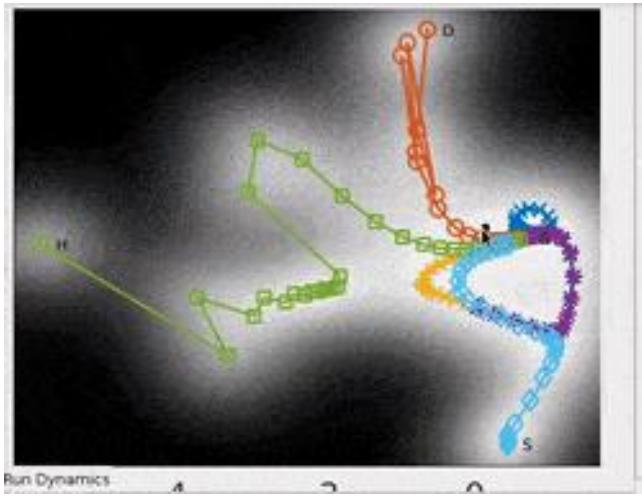
Medical images analysis

- Some results

Emotion Analysis

- Reconstruction of a facial expression space by:
  - Video analysis (extraction of characteristics, use of Gaussian Processing to build the latent space)
  - Analysis of physiological signals (heartbeat, sweating level, dilation of the pupil)
- Data acquisition by specific sensors
- Detection of physiological signals by video analysis



Surgical operations with Augmented Reality

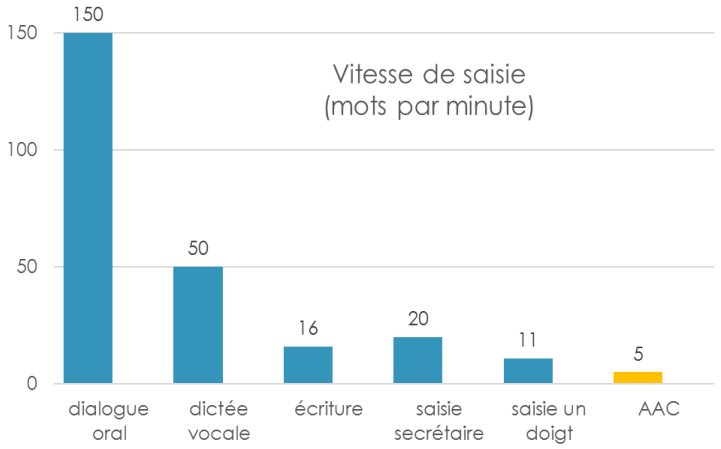
Putting shoulder prosthesis using augmented reality glasses

- Before and during the operation
- Visualize 3D anatomical models of the prosthesis or the patient shoulder to prepare the different stages of the surgical procedure
- Visualize anatomical models, additional guides or information to facilitate the intervention

Help in communication with NLP

Heavily disabled people

- Cerebral palsy (post-stroke), amyotrophic lateral sclerosis, tetraplegia ...
- No more access to the physical keyboard ➔ virtual keyboard ➔ slow input



Linguistic Prediction

- Dynamic reorganization of the keyboard to accelerate access to the correct letter.
- Lexical prediction: predict the right word to avoid its keyboarding

Help in communication with NLP

Statistical language model

- *Design for all* – Same goal as prediction of words on smartphone, but advanced prediction model
- Automatic learning on specific corpus

$$\lambda \cdot P_{général}(w_i) + (1 - \lambda) \cdot P_{utilisateur}(w_i)$$

General Model (**N-gram**)

Wikipedia, Le Monde….

User Model (**N-gram**)

Saisies utilisateur

$$P'(w_i) = \frac{P_{base}(w_i)^{\lambda_1} \cdot P_{LSA}(w_i)^{(1-\lambda_1)}}{\sum_{j=1}^{n} P_{base}(w_j)^{\lambda_1} \cdot P_{LSA}(w_j)^{(1-\lambda_1)}}$$

Semantic Adaptation

Latent Semantic Analysis (LSA) or word embedding (**deep learning**)

Results

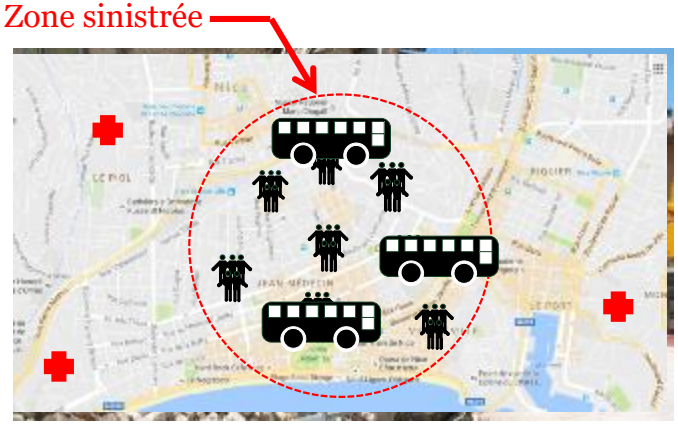
- Quality of Prediction: Letter Saving Economy Rate

Modèle	Unigram	Bigram	Trigram	+ sémantique
KSR	43.9 %	51.2 %	55.8 %	57.8 %

- Used by numerous patients (Centre de Kerpape, Garches)

Optimisation of city evacuation

- Models and tools for planning a city evacuation in case of natural disaster



Provide decision support tools for evacuation (ANR/BMBF DSS_EVAC_LOGISTIQUE).

Theoretical models applied to cities of Nice (Fr) and Kaiserslautern (Ge)

Can we develop optimization algorithms for the assignment and transport of people by bus and car … guaranteeing rapid and secure evacuation?

Problems

- Determine the location of rescue centers [location and transport models],
- Assign the population to the rescue centers [scheduling / assignment models],
- Plan bus and car transportation from assembly points to rescue centers [transport models],

- Development of complex scheduling and transport models, resulting from a dialogue with the actors in the field,
- Proposed efficient optimization algorithms to plan the evacuation of 35,000 people (Nice),
- Franco-German collaboration (University of Tours / University of Kaiserslautern),
- Scientific assessment: 6 international journals, 11 international conferences, 7 national conferences,
- Technological balance: realization of a Visual Flow software prototype..

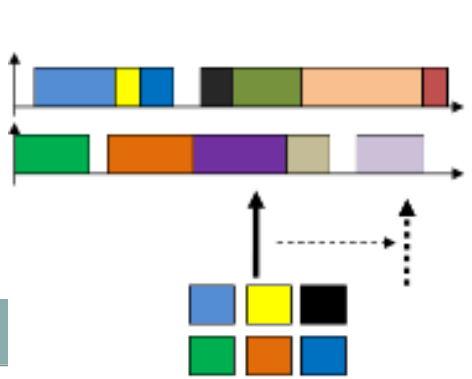
Contributions

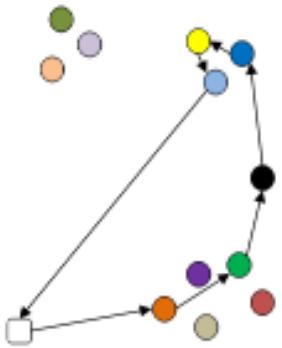
Production and Planning of Chemotherapies

- A Regional project
  - In collaboration with Tours Hospital (UBCO) and a company (Eticsys)
  - UBCO is in charge of producing all chemotherapies (over 35,000 / year). Average cost of a chemo: 2000 €
- Stages related to the production of chemo
  - Prescription by the doctor
  - Validation of the patient's condition to take the chemo ➔ launch of the production of chemo
  - Sterilization of cytotoxic drugs to constitute chemo ➔ Constitution of chemo
  - Chemo analysis
  - Delivery of the chemo to the hospital
  - Administration of chemo to the patient

Production and Planning of Chemotherapies

- Dynamic problem + Strong constraints (real time)
  - delay of less than 1h30 for the production starting from the validation (no production in advance possible)
  - duration of operation is different for each chemo
  - delays of chemical stabilities to be respected
  - several delivery men
- Decision variables: which insulator, which operator, at what time, in what order, when to deliver and in what order, how many tours, etc.
  - Mathematical modeling ➔ constraint programing and Meta-heuristics
  - Tool currently in production ➔ Integration into a software suite (OncoSuite) integrating traceability management and production monitoring





The LIFAT in a few words…

DATA SCIENCE, ARTIFICIAL INTELLIGENCE, DECISION SUPPORT, OPTIMISATION
without forgetting the Human

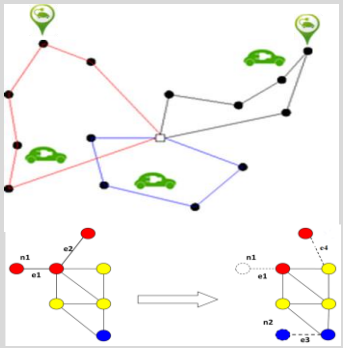
The LIFAT in a few words…

DATA SCIENCE, ARTIFICIAL INTELLIGENCE, DECISION SUPPORT, OPTIMISATION
without forgetting the Human

DATA

Web data, sensors
Data warehouses, web data
Integration of heterogeneous data

Structured data,
complex systems



3D acquisition equipment
Documents, 3D Images,
Videos …

NEW ALGORITHMS

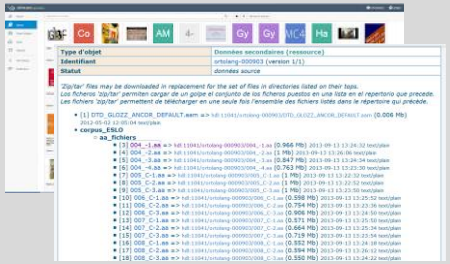
Data Science
- Exploratory Data analysis,
- Data mining,
- Visual data mining
- visualization

Artificial intelligence
- Automatic learning
- Pattern Recognition
- Image and video analysis
- Automatic Language Processing
- Interactivity and Augmented Reality

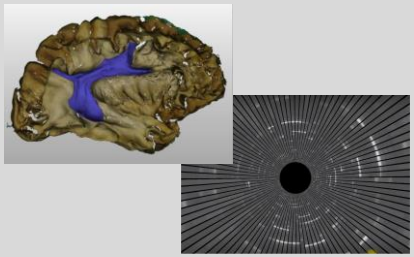
Operational research
- Theoretical complexity
- Exact / approx. methods
- Robustness
- Scheduling, Transport

APPLICATIONSNS

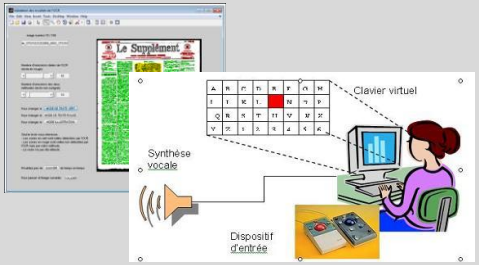
Resource and corpus creation



Visualisation, interaction



Decision support



The LIFAT in a few numbers…

WORKFORCE

>90 Members (Univ Tours, Polytech, INSA)

15 Professors
34 Assistant professors
21 HDR

3,2 BIATSS ETP

31 PhD students
- **60%** foreigners
- **3** cotutelles
- **7** CIFRE

11 post-doc & temporary contracts

2/3 invited researchers each years (1 month+)

PUBLICATIONS (5 last years)

109 Publications ACL

24% national collaboration
25% Journal with IF > 2
37% with international colleagues
63% in Q1 journals
73% in Q1 or Q2 journals

261 Communications in international conferences

136 Communications in national conferences

1 Book

24 book contributions

1 Patent

PROJECTS
(5 last years)

1 COST Network
1 CEFIPRA
1 ANR international
8 ANR
3 Investissements d'Avenir
1 PEPS CNRS
3 FEDER
26 Région

TRAINING

2 Engineer trainings

1 Erasmus Mundus Master

1 Master

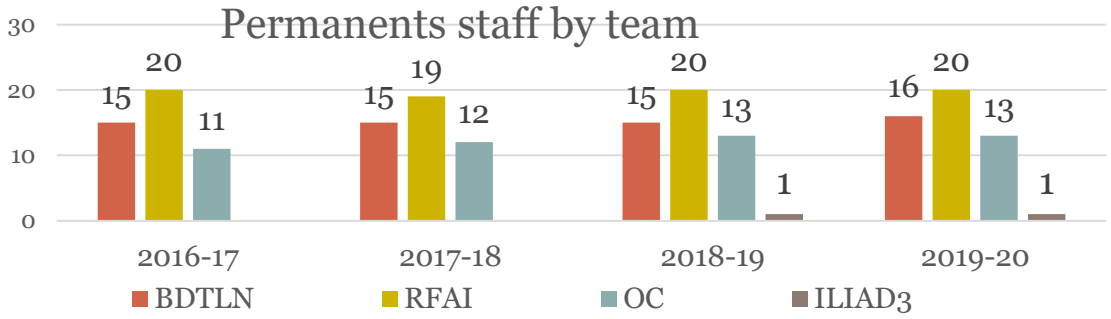
BUDGET (5 last years)

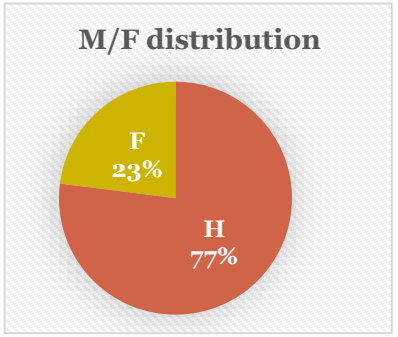
Total amount : **5 M€**

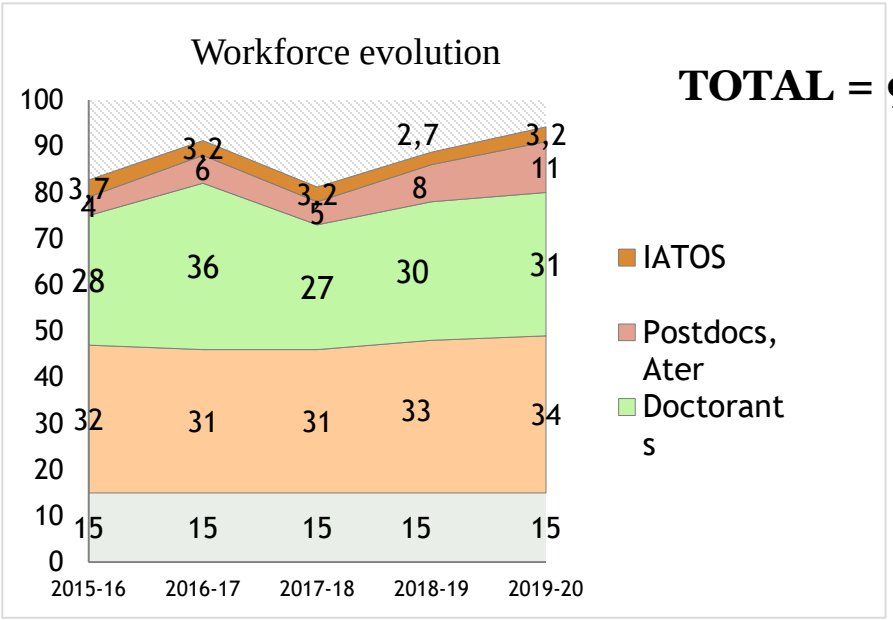
• ANR Projects :	1,1 M€
• Regional Projects :	1,6 M€
• Industrial Projects :	0,7 M€
• Recurrent Budget (env. 13%) :	0,6 M€
• International Projets :	0,5 M€

Thanks

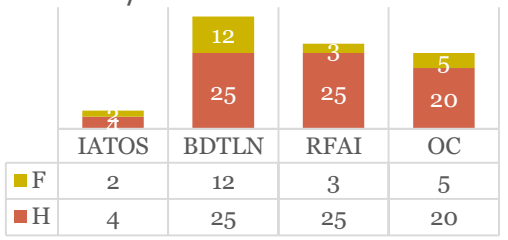
Evolutions in the workforce

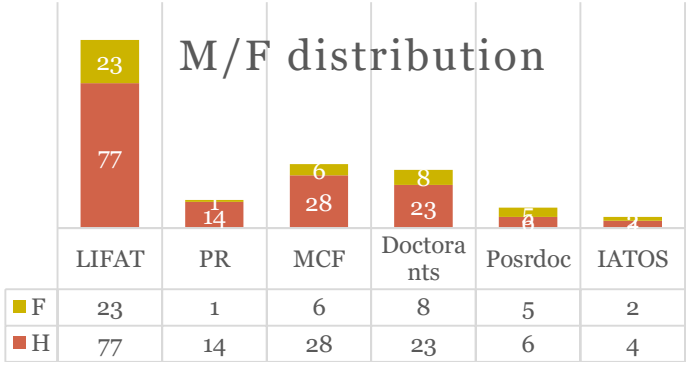






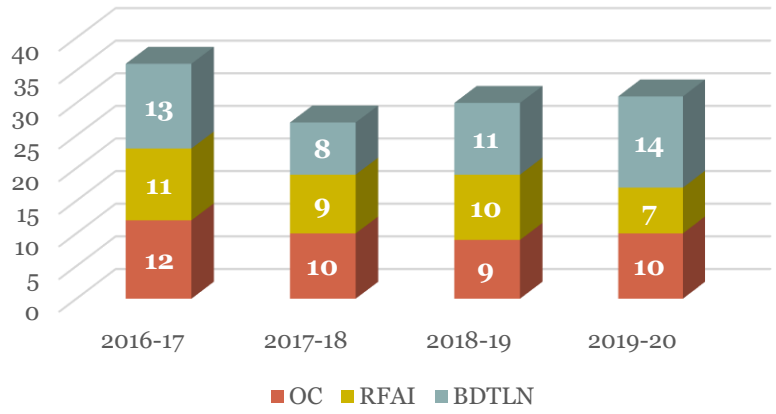
TOTAL = 95.2 members



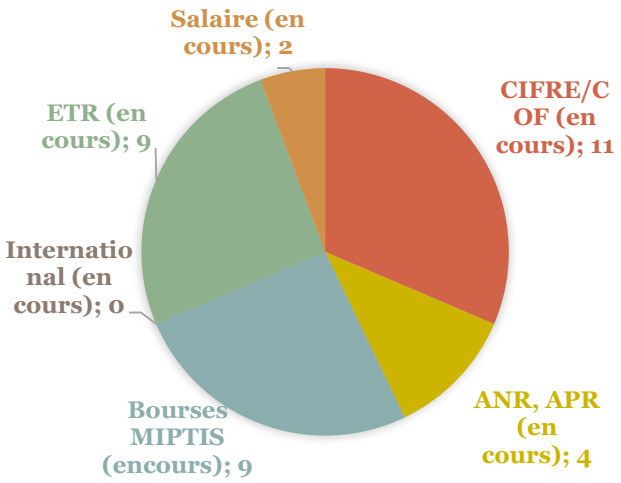


PhD & HDR

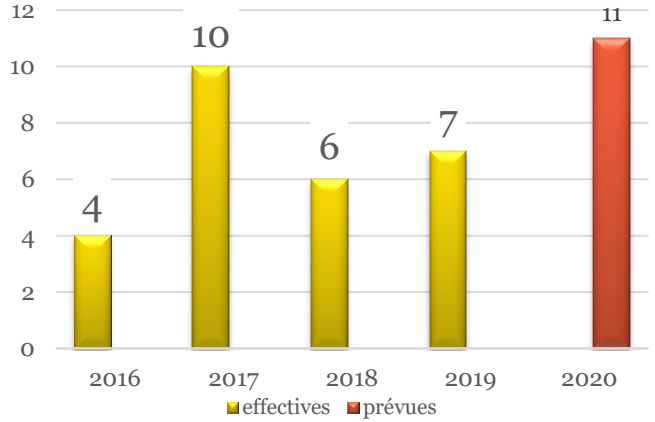
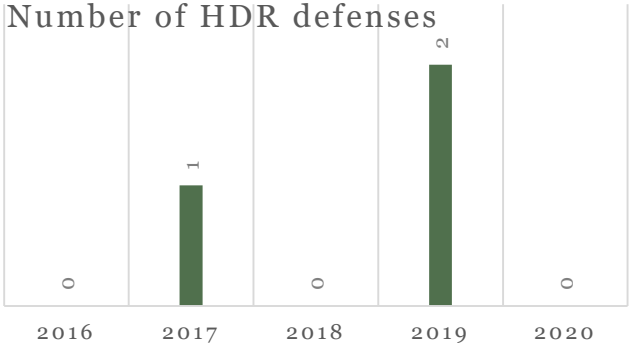
PhD by Team



PhD funding



Number of PhD Defenses



Number of HDR defenses